

Trunk Cards

This chapter describes the hardware and functionality of IGX trunk cards. The description of each card includes:

- Function
- System interconnect
- Faceplate indicators

Other publications that relate to IGX operation are:

- The *Cisco IGX 8400 Series Installation and Configuration* publication describes installation, troubleshooting, user commands, repair and replacement, and the rack-mount Cisco IGX 8420-to-IGX 8430 conversion.
- The *Cisco WAN Switching Command Reference* publication and the *Cisco WAN Switching SuperUser Command Reference* publication describe standard user commands and superuser commands.
- The *Cisco WAN Manager Installation* publication and the *Cisco WAN Manager Operations* publication both contain information on network management.

Trunk Interface Cards

This section describes the IGX trunks. The card groups are:

- Universal switching module enhanced (UXM-E)
- Network trunk module (NTM)

Note With Release 9.2 and later software, an Cisco IGX 8420 or 8430 switch can support a maximum of 32 trunks.

Table 4-1 lists the trunk front cards, and Table 4-2 lists the corresponding trunk interface back cards.

Table 4-1 Trunk Front Cards

Card Acronym	Card Name
UXM-E	Universal switching module
NTM	Network trunk module

Table 4-2 Interface Back Cards for Trunks

Back Card Acronym by Trunk	Card Name
UXM-E	
BC-UAI-4-155-MMF	4-port multimode fiber 155Mbps
BC-UAI-4-155-SMF	4-port single mode fiber 155Mbps
BC-UAI-2-155-SMF	2-port single mode fiber 155Mbps
BC-UAI-2-SMFXLR	2-port single mode fiber XLR
BC-UAI-4-SMFXLR	4-port single mode fiber XLR
BC-UAI-4-STM1E	4-port synchronous transport module-1E
BC-UAI-6-T3	6-port T3 back card
BC-UAI-3-T3	3-port T3 back card
BC-UAI-6-E3	6-port E3 back card
BC-UAI-3-E3	3-port E3 back card
BC-UAI-8-T1-DB-15	8-port T1 back card with DB-15 connector
BC-UAI-8-E1-DB-15	8-port E1 back card with DB-15 connector
BC-UAI-8-E1-BNC	8-port E1 back card with BNC connector
BC-UAI-4-T1-DB-15	4-port T1 back card with DB-15 connector
BC-UAI-4-E1-DB-15	8-port E1 back card with DB-15 connector
BC-UAI-4-E1-BNC	4-port E1 back card with BNC connector
NTM	
BC-E1	E1 interface card
BC-T1	T1 interface card
BC-Y1	Y1 trunk interface card
BC-SR	Subrate trunk interface card

Trunk Operating Modes

IGX trunk cards operate in either *simple gateway* or *cell forwarding* mode. Simple gateway supports *service interworking*, which lets Frame Relay connections terminate at ATM endpoints. For a description of simple and complex gateways, service and network interworking, tiered networks, trunks, ATM protocols, and cell and header formats, refer to the *Cisco Systems Overview*.

Trunk Card Maintenance

Trunk cards require no maintenance except for replacement after a confirmed failure.

Loopback Test

A trunk loopback test runs when an ATM trunk detects an integrated alarm. The loopback test indicates if the line or the card is faulty. A loopback test “pass” means the *line* is faulty, so a line alarm is subsequently indicated. A loopback test “fail” means the *card* is faulty. If the card is faulty, a switch occurs to an available Y-cable equipped redundant card.

Common Alarms, Controls, and Indicators

Front cards and back cards have faceplates with indicator LEDs. Most cards have both a green Active LED and a red Fail LED at the bottom of the faceplate. For definitions of the port status LEDs on a back card, refer to the section that describes the back card. Table 4-3 describes the common card status indicators for LEDs.

Note In slots where no back card exists, a blank faceplate must reside to block Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) and to ensure correct air flow.

Table 4-3 Common Card Status Indicators

Indicators	Status	Meaning
Fail	ON Steady	Indicates an error occurred. First, reset the card with the resetcd f command. If the LED comes on again, call the TAC.
Fail	Blinking	On an NPM in a redundant system, this combination indicates that the card is being updated.
Active	ON steady	When steadily on, this combination indicates the card is active and carrying traffic or processing data.
Active	ON momentarily	When momentarily on, indicates the card executed a self-test.
BOTH	OFF	Indicates the card is either part of a redundant pair and is in standby or is not being used at all.
BOTH	ON	Indicates the card failed but remains active because no standby card is available. One or more lines failed, but others remain active.

Universal Switching Module Enhanced

This description of the universal switching module (UXM-E) covers the following topics:

- An introduction includes sections on the UXM-E mode of operation, trunk-mode features, interface card list, card redundancy, card mismatch, clock sourcing, cellbus bandwidth usage, configuration for public ATM network service, and configuration for cell trunk-only routes
- Supported traffic and connection types
- Inverse multiplexing over ATM (IMA)
- Activation and configuration of a UXM-E for trunk-mode operation
- Supported traffic and connection types
- Alarms for physical lines and logical (IMA) trunks
- Descriptions of the faceplates on the back cards

The universal switching module (UXM-E) can function in one of two modes. In *trunk mode*, the UXM-E supports trunks in the network. In *port mode*, it is either an ATM User-to-Network Interface (UNI) or a Network-to-Network interface (NNI). The back cards support multiple ports operating at OC3/STM1, T3, E3, T1, or E1 rates.

Note The word “port” has two uses in a Cisco WAN switch. “Port mode” refers to the function of an interface at the edge of a network—the endpoint at which you add connections (UNI) or the interface between two networks (NNI). Examples of port cards are the UVM, UFM, ALM/A, and port-mode UXM-E in an IGX switch or an ASI in a BPX switch.

On the other hand, a “port” is also a layer of logical functionality that applies to port cards as well as trunk cards. For example, whether you activate a line to a router or activate an ATM trunk to the network, you must subsequently configure the logical port in either case.

For a UXM-E, therefore, the documentation describes a logical “port” on a port-mode UXM-E for a UNI or NNI at the edge of a network, yet it also refers to a “port on a UXM-E trunk” as a layer of logic.

Introduction to the UXM-E Trunk Mode

The UXM-E can transport ATM cells to and from the cellbus at a maximum rate of 310 Mbps in either direction. The UXM-E can support up to 8000 total connections in trunk mode.

Note The UXM-E in trunk mode cannot support more than 4000 gateway connections. All remaining connections can be either user or networking connections. For example, if you configure 2500 gateway connections, you still have 5500 connections available to be used for user or networking connections.

The UXM-E communicates only ATM cells to either the network or the CPE. On the cellbus, however, the UXM-E communicates either ATM cells or FastPackets according to the card type. With another UXM-E, it communicates only in ATM cells. With other cards, the UXM-E communicates in FastPackets. Through its gateway functionality, the UXM-E translates between FastPackets and ATM cells so it can transport voice, data, or Frame Relay traffic that other cards have put in FastPackets.

Determining the UXM-E's Mode of Operation

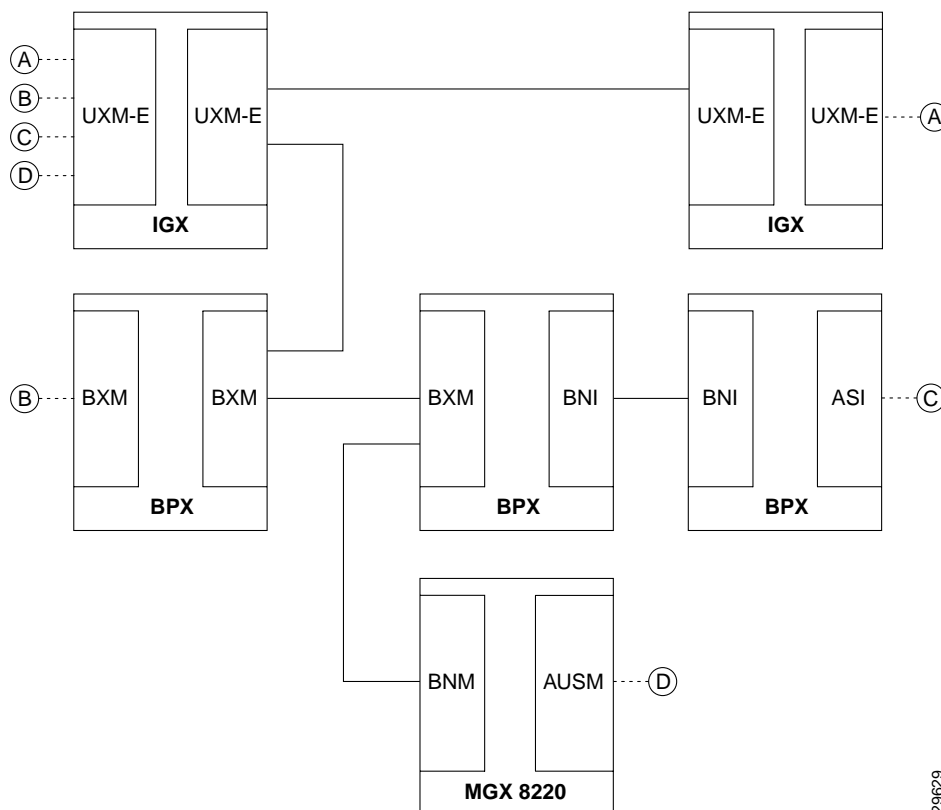
The UXM-E detects reports its mode of operation to switch software when you first activate either a trunk to the network or a line on the UNI or NNI. If you activate a trunk, the UXM-E goes into trunk mode. If you activate a line, the UXM-E goes into port mode. The CLI commands for these operations are **uptrk** and **upln**, respectively. (The UXM-E description in this chapter lists important information about the commands that apply to the UXM-E, but the order of their use appears in the *Cisco IGX 8400 Series Installation* guide. For a detailed description of each command and its parameters, see the *Cisco WAN Switching Command Reference*.)

Example Networks with UXM-Es

Networks with both trunk mode and port mode UXM-Es appear in Figure 4-1 and Figure 4-2, respectively. The nodes in Figure 4-1 use only UXM-Es for port interfaces and trunk interfaces. Figure 4-2 shows a variety of cards providing interfaces for different traffic types.

The network carrying only ATM traffic appears in Figure 4-1. Each UXM-E trunk card in Figure 4-1 connects to either another UXM-E trunk card or a BXM operating as a trunk. The ATM UNI ports are the UXM-E port cards (for connection A), the BXM operating in port mode (for connection B), the ASI (for connection C), and the BXM feeder trunk (for connection D). Connection D is a two-segment connection. One segment of connection D exists between the BNM and AUSM on the Cisco MGX 8220 shelf, and the other segment exists between the BXM and the UXM-E UNI port.

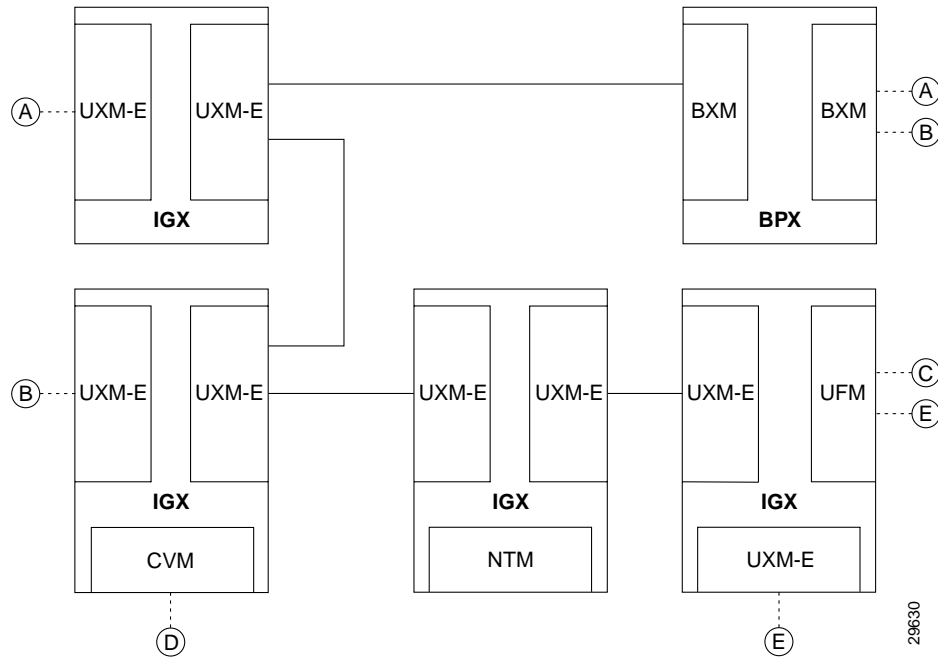
Figure 4-1 UXM-Es in a Network with Pure ATM Traffic



A network with ATM traffic and FastPacket-based traffic appears in Figure 4-2. Connections A and B are ATM connections that terminate on UXM-E UNI port cards and a BXM operating as a UNI port. Connection C is a Frame Relay connection between a UFM and an FRM. Connection D is a

voice connection between a CVM and CDP. Connection E is a local connection (DAXCON) between a UFM and a UXM-E UNI port on the same node. For connections C–E, the gateway function of the UXM-E packs and unpacks the FastPackets into and out of the ATM cells.

Figure 4-2 UXM-Es in a Network with Heterogeneous Traffic



UXM-E Trunk Features

The following list broadly identifies the features of a UXM-E trunk. After the bulleted list, the remaining sections of this introduction contain tables that list the features on particular topics, such as interworking. Actual descriptions of the features appear in the section “The UXM-E in Trunk Mode” on page 13.

- The UXM-E uses all four lanes of the cellbus.
- In trunk mode, the UXM-E supports up to 8000 connections.

Note The UXM-E in trunk mode cannot support more than 4000 gateway connections. All remaining connections can be either user or networking connections. For example, if you configure 2500 gateway connections, you still have 5500 connections available to be used for user or networking connections.

- The maximum throughput is 310 Mbps—two times the OC-3 (STM1) rate. This maximum applies whether the back card is a 2-port or 4-port back card. In practical application, this maximum rate means that most trunk applications with an OC-3 interface would use the 2-port back card.
- The UXM-E supports ATM-to-Frame Relay network and service interworking.
- For the ABR connection types, the UXM-E supports EFCI marking, Explicit Rate Stamping, and Virtual Source/Virtual Destination (VS/VD).
- The UXM-E supports Y-cable redundancy with hot standby for very fast switchover.
- The front card has 128K cell buffers.
- For statistics support, the UXM-E provides real-time statistics counters and interval statistics collection for ports, lines, trunks, and channels.
- The UXM-E can form a logical trunk by grouping more than one T1 or E1 port. The name of this (purchased) option is Inverse Multiplexing over ATM (IMA).
- The on-board diagnostics are *loopback*, *self-test*, and *background*.

UXM-E Interfaces

Table 4-4 is a list of the UXM-E back cards. Figure 4-3 shows the UXM-E front card. Table 4-5 defines all possible combinations for the states of the front card status LEDs (Fail, Active, and Standby).

Table 4-4 Back Cards for the UXM-E

Card Name	Card Description
BC-UA1-4-155-MMF	4-port multimode fiber 155 Mbps
BC-UA1-4-155-SMF	4-port single mode fiber 155 Mbps
BC-UA1-2-155-SMF	2-port single mode fiber 155 Mbps
BC-UA1-2-SMFXLR	2-port single mode fiber XLR
BC-UA1-4-SMFXLR	4-port single mode fiber XLR
BC-UA1-4-STM1E	4-port synchronous transport module-1E
BC-UA1-6-T3	6-port T3 back card
BC-UA1-3-T3	3-port T3 back card
BC-UA1-6-E3	6-port E3 back card
BC-UA1-3-E3	3-port E3 back card
BC-UA1-4-T1-DB-15	4-port T1 back card with DB-15 connector
BC-UA1-8-T1-DB-15	8-port T1 back card with DB-15 connector
BC-UA1-4-E1-DB-15	4-port E1 back card with DB-15 connector
BC-UA1-8-E1-DB-15	8-port E1 back card with DB-15 connector
BC-UA1-4-E1-BNC	4-port E1 back card with BNC connector
BC-UA1-8-E1-BNC	8-port E1 back card with BNC connector

Figure 4-3 UXM-E Front Card

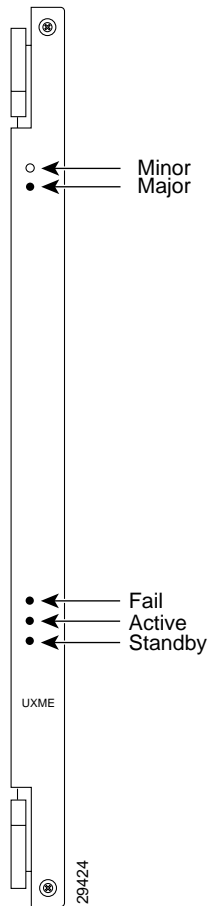


Table 4-5 UXM-E Status LEDs

Fail	Active	Standby	Status of Card
On	Off	Off	Failed
Blinking	Blinking	Off	Back Card Mismatch (hot standby)
Blinking	On	Off	Back Card Mismatch (active)—can be missing back card
Blinking	Off	Blinking	Back Card Mismatch (self-test)
Blinking	Off	On	Back Card Mismatch (standby)
Off	Blinking	Off	Hot Standby
Off	On	Off	Active
Off	Off	Blinking	Self-test
Off	Off	On	Standby
On	On	On	Down

Maximum Number of UXM-Es

Switch software limits the number of logical trunks and ports on an IGX switch. The maximum number of UNI or NNI ports in an IGX switch is 64. The maximum number of logical trunks is 32. To determine the number of each logical type in the switch, add the number of ports on multiport cards and single-port cards. These sums cannot exceed 64 ports and 32 trunks. For example, using exclusively 2-port OC3 trunks, you could install:

$$2 \text{ trunks per card} \times 16 \text{ OC3 UXM-Es} = 32 \text{ trunks}$$

Switch software monitors the number of logical ports and trunks, not the number of UXM-Es. Therefore, the software keeps you from activating an excessive number of lines or trunks on the node rather than flagging the presence of too many cards.

Y-Cabled UXM-E Redundancy

The UXM-E features *hot standby* as a part of its Y-cable redundancy capability. With hot standby, the redundant card receives the configuration information as soon as you finish specifying redundancy. The standby card also receives updates to its configuration as the active card configuration changes. Hot standby lets the backup card go into operation as soon as necessary rather than waiting for the NPM to download the configuration.

Y-cable redundancy requires that both cards are active and available before you set up redundancy. Use Cisco WAN Manager or the CLI commands **uptrk**, **addtrk**, then **addyred**. (See also descriptions of **addyred**, **delyred**, **dspyred**, and **ptyred** in the *Cisco WAN Switching Command Reference* publication.)

Switchover to a Redundant UXM-E

If the card fails, a switchover occurs to a Y-cabled, redundant UXM-E card set if available. If the switchover occurs, the primary UXM-E acquires failed status, and the Fail LED turns on.

Card Mismatch

The UXM-E supports two types of card mismatch notification. The notification common to all cards occurs when you connect an unsupported back card to the front card. The mismatch notification unique to the UXM-E occurs if you attach a supported back card but one that has a different interface or a *smaller* number of the *correct* line types than what the UXM-E previously reported to software.

The UXM-E informs switch software of the number and type of interface ports when you first activate a UXM-E. Software retains the back card configuration data if you remove it. If you subsequently attach a card with fewer ports, switch software flags a mismatch. Replacing a back card with *more* ports of the *same* line type or exchanging SMF and MMF OC3 (STM1) cards is not a mismatch. To change the interface that software has on record, you must first down the card then reactivate it.

The UXM-E as a Clock Source

A UXM-E line or trunk can be the clock source for the node. Use the **dspclksrcs** command to display available clock sources, **dspcurclk** to show the current clock source, and **cnfclksrc** to specify a new clock source. To clear clock alarms, use **clrcalkalm**.

Cellbus Bandwidth Usage

The cellbus consists of four operational lanes plus one backup lane. (The backup lane becomes active if a lane fails.) The FastPacket-based cards can use only one lane and communicate only in FastPackets. If a FastPacket-based card controls the cellbus, no ATM cells can be on the cellbus.

When the UXM-E has control of the cellbus, it can pass any of the following:

- ATM cells on all lanes (for example, with a daxcon between UXM-Es or when one UXM-E communicates with another UXM-E in the same switch)
- FastPackets on lane 1 simultaneously with ATM cells on lanes 2 through 4
- FastPackets on lane 1

Switch software monitors and computes cellbus bandwidth requirements for each card in the Cisco 8400 series switches. For the UXM-E alone, you can change its cellbus bandwidth allocation. (You cannot view or alter bandwidth allocation for other cards.) The unit of measure for the ATM cell and FastPacket bandwidth on the cellbus is the universal bandwidth unit (UBU).

Switch software allocates a default number of UBUs for the card when the UXM-E identifies the back card interface to switch software. If you remove a card, switch software reserves the current cellbus bandwidth allocation for that card. If, as you add more connections, the load approaches oversubscription, switch software displays a warning message. Regardless of the warning message, Cisco recommends that you monitor bandwidth allocation and allocate more UBUs for the card to avoid oversubscription.

For the UXM-E, switch software allocates enough bandwidth to meet the requirements for the minimum cell rate (MCR) and therefore does not accommodate burstiness. Therefore, you must know the UXM-E bandwidth requirements to determine if you should change its UBU allocation. Monitor the bandwidth requirements after you build the network and during normal operation. On the CLI, the applicable commands are **cnfbusbw** and **dspbusbw**.

You can raise, lower, or check a UXM-E's UBUs with **cnfbusbw**. The **cnfbusbw** privilege level is 0—superuser. To check a UXM-E's UBUs, use **dspbusbw** or **cnfbusbw**. Any user can use **dspbusbw**. Each command's display provides the information you need to determine if you must increase the UBUs on a particular UXM-E. The only value you can change is *allocated bandwidth*.

The *card-based* default and maximum cellbus bandwidth for each interface appears in Table 4-5. Note that FastPackets require substantially less cellbus bandwidth than ATM cells. The FastPacket requirements in the figure and table reflect the restriction of FastPackets to one lane and the maximum processing rate of the gateway on the UXM-E.

The values you can view with the **cnfbusbw** and **dspbusbw** commands are:

- *Minimum Required Bandwidth*, the necessary bandwidth that switch software has calculated for the existing connections on the local UXM-E. The display shows the requirements for FastPackets, ATM cells, and the equivalent in total UBUs.
- *Average Used Bandwidth* is the average bandwidth usage.
- *Peak Used Bandwidth* is the peak bandwidth usage.
- *Maximum Port Bandwidth* is the maximum bandwidth that the back card can support. The FastPackets per second field has a dash-mark because only cells pass through the port.
- *Allocated Bandwidth* is the current cellbus allocation for the card. The field shows the UBUs, the bandwidth when only ATM cells are on the bus, and cells plus Fastpackets. The reason for cells alone and cells plus Fastpackets is that cells can exist on the cellbus with or without FastPackets. The last field under *Allocated Bandwidth* shows the formula to which the allocated values must adhere. (A description of the formula follows the example screen.)

Table 4-6 Cellbus Bandwidth Allocation for UXM-E Interfaces

Inter- face Type	Ports	Default UBUs	Default Cell Traffic Only (cps)	Default Cell + Fpkt Traffic (cps and fps)	Max. UBUs	Max. Cell Traffic Only (cps)	Maximum Cell + Fpkts Traffic (cps and fps)
OC3	4 or 2	44	176,000	132,000, 88,000	235	708,000	473,000, 470,000
T3	6 or 3	24	96,000	72,000, 48,000	235	708,000	473,000, 470,000
E3	6 or 3	20	80,000	60,000, 40,000	235	708,000	473,000, 470,000
T1	8	8	32,000	24,000, 16,000	32	128,000	96,000, 64,000
T1	4	4	16,000	12,000, 8,000	16	64,000	48,000, 32,000
E1	8	10	40,000	30,000, 20,000	40	160,000	120,000, 80,000
E1	4	5	20,000	15,000, 10,000	20	80,000	60,000, 40,000

Planning for Cellbus Bandwidth Allocation

With the Network Modeling Tool™ (NMT), you can use the projected load for all UXM-Es in the network to estimate their cellbus requirements. During normal operation, you can use Cisco WAN Manager to obtain the trunk and port statistics then decide whether to use **cnfbusbw** to increase the UBU allocation. If you are using only the CLI, you would need to establish a virtual terminal (**vt**) session to each node then execute **dspbusbw** or **cnfbusbw**.

Calculating Cellbus Bandwidth Changes

To determine how many UBUs are necessary, use the values for *average bandwidth used* in the following formula:

$$UBUs = \frac{\frac{fps}{2} + cps}{4000}$$

In most circumstances, the *fps* and *cps* values from *average bandwidth used* are sufficient. The *peak bandwidth used* values are primarily informational.

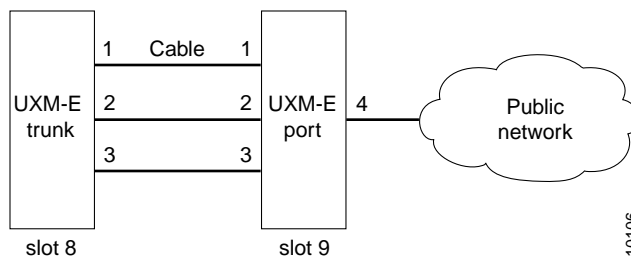
The information in Table 4-5 provides the ranges for the interface type. Note that, if you do the math according to the formula, you see that the value in the cells-alone column of Table 4-5 equals the result of adding half the FastPacket value to the cell value in the cells plus FastPackets column.

When you use **dspsbusbw**, a yes/no prompt asks if you want firmware to retrieve the usage values. If you enter a “y,” the UXM-E reads—then clears—its registers and thus restarts statistics gathering. If you enter an “n,” switch software displays the current values that reside in control card memory (on the NPM). The values in memory come from the last update from the UXM-E.

ATM Across a Public ATM Network

The UXM-E can support trunking across a public ATM network so both virtual channel connections (VCCs) and virtual path connections (VPCs) traverse a single virtual path trunk. This feature lets you map multiple trunks to a single port of an NNI. The NNI connects to either a public or private ATM network. The virtual trunk package is a lower-cost alternative to leased circuits but still has the full set of Cisco ATM traffic management capabilities. This application requires two UXM-Es and a clock from an external source. The rates can be OC-3/STM-1, T3/E3, or T1/E1.

Figure 4-4 UXM-Es Configured for a Public ATM Network



Note the following characteristics of this form of trunking across a public network:

- The trunk cannot provide the a clock for transport across the public network.
- This feature does not support VPC connections across the public network.
- The node number at each endpoint must be 17 or higher.

Refer to Figure 4-3 as you read the steps for the following example set-up:

Step 1 Connect a cable between each of the following:

- 8.1 and 9.1
- 8.2 and 9.2

- 8.3 and 9.3
- 9.4 and the public network

Step 2 Configure trunk 8.1, 8.2, and 8.3 to use VPC 101, 102, and 103, respectively.

Step 3 Add 3 VPC connections from 9.1, 9.2, and 9.3 to 9.4. At the far end, use the same VPCs.

Routing over Cell Trunks Only

You can specify *trunk cell routing only* as an option when you add a connection between UXM-E, ASI, or BXM ports. When you enable trunk cell routing, switch software routes across only the cell-based trunk cards BNI, BXM, and UXM-E: no conversion to FastPackets occurs on the route. If you disable trunk cell routing, the routing process can select a FastPacket-based trunk and so decrement the number of available gateway connections. Also, using a FastPacket-based trunk may result in increased network delays. Therefore, enabling trunk cell routing is the preferred choice when you add a connection at a BNI, BXM, or UXM-E.

If you add connections at other port cards, such as a UFM or ALM/A, switch software does not display the trunk cell routing option.

On the CLI, the **addcon** prompt for this option appears as “trunk cell routing restrict y/n?” It appears after you enter either the ATM class of service or after you finish specifying all the individual bandwidth parameters that apply to the current connection type. You can specify whether the default for trunk cell routing is “Yes” or “No” through the **cnfnodeparm** (superuser) command.

The UXM-E in Trunk Mode

The UXM-E trunk can communicate ATM cells that originated at an ATM endpoint or—through its on-board gateway functionality—FastPacket-based traffic such as voice, data, and Frame Relay. A UXM-E trunk can connect to the following trunk cards:

- UXM-E
- BXM

Types of Supported Traffic

As previously stated, the UXM-E trunk can connect to only another UXM-E trunk or a BXM trunk. On the other hand, the types of traffic that traverse a UXM-E trunk can originate at ATM ports or other types of ports. The types of traffic that a cell on a UXM-E trunk can carry appear in Table 4-7. Table 4-7 shows the traffic types that ATM cells can carry where the payload originated as a FastPacket.

Table 4-7 Traffic from FastPacket-Based Cards

Traffic Type
Timestamped
Non-timestamped
Voice
Bursty data A
Bursty data B
High priority
CBR, VBR, ABR

Types of Connections on a UXM-E Trunk

This section introduces the connections that a UXM-E trunk supports. The context of each description is the trunk rather than the connection endpoints. The purpose of these descriptions is not only to inform but also help you plan the network. Some definitions overlap because a connection may qualify as more than one type.

- A *Cell connection* carries information that exists in ATM cell format throughout the path. On a UXM-E trunk, therefore, the only *cell* connections are those that have originated on a UXM-E port at one end and remain in cell format throughout the connection.
- A *Gateway connection* carries information that normally exists in ATM cell format but is translated to FastPacket format for some purpose at some point along the path. Reason for the translation could be that the connection terminates on a FastPacket-based card, is a network connection, or includes a FastPacket-based trunk card in the route.
- A *Networking connection* carries network messages between nodes and terminate as FastPackets (and therefore are also gateway connections).
- A *User-connection* is a connection that a user has added at the current node. User-connections can be cell connections or gateway connections. User connections are mutually exclusive of via connections and network connections.
- A *Via connection* passes through a node and does not terminate on the node. You can neither view nor alter a via connection because the connection does not terminate on the node (the node that owns the connection has made the via node and trunk a part of the route).
- An *Interworking connection* is a service or network interworking connection in which one end terminates as ATM and the other as Frame Relay. Interworking connections are a subset of gateway connections.

Operating as a trunk, the UXM-E carries up to 8000 connections. A via connection can be either a cell-type or a gateway-type.

Because network messages use gateway channels, they subtract from the total number of available gateway connections. For each *active* port, the UXM-E reserves 270 gateway connections for networking regardless of the interface type. Therefore, with a fully-utilized 8-E1 or 8-T1 back card, the UXM-E reserves up to 2160 connections. Because these numbers potentially represent a very significant reduction in the number of gateway connections for user-data, switch software lets you specify a maximum number of active ports on the back card. The most applicable interfaces for this capability are the T1 and E1 ports, especially with Inverse Multiplexing Over ATM (IMA). See the section “Inverse Multiplexing over ATM on IGX Trunks” for the description of IMA.

You can specify the maximum number of *logical* trunks that can be active on a card through Cisco WAN Manager or the CLI. The applicable CLI command is **cnftrkport**. For example, if you intend an eight-port card to have two logical (IMA) trunks, you can use **cnftrkport** to specify a maximum number of two trunks. Software would therefore reserve 540 connections for network messages rather than the 2160 connections if you did not specify a maximum.

Inverse Multiplexing over ATM on IGX Trunks

Inverse Multiplexing over ATM (IMA) lets you group physical T1 or E1 lines to form a logical trunk. A logical trunk consisting of more than one T1 or E1 line supports connections with data rates that are much higher than the T1 or E1 rate. System software lets you specify IMA so that one or more physical lines within the logical trunk can serve as backup if a line fails.

IMA characteristics are as follows:

- All physical ports of an IMA trunk use the same line configuration.
- The node maintains a set of *retained links* for the IMA trunk to keep it active. The IMA trunk does not fail unless the number of active trunks is less than the user-specified number of retained links.
- The IMA trunk can provide a clock source or clock path (see **cnftrk** command). The first (the lowest numbered) available physical line is used. If this line fails, the next available line within the IMA provides the clock source or clock path.
- Full support for individual physical line alarms and statistics.

To specify the range of ports for an IMA trunk, you can use either Cisco WAN Manager or the command-line interface (CLI). To define an IMA trunk on the CLI, use the **uptrk** command:

uptrk *slot.start_port-end_port*

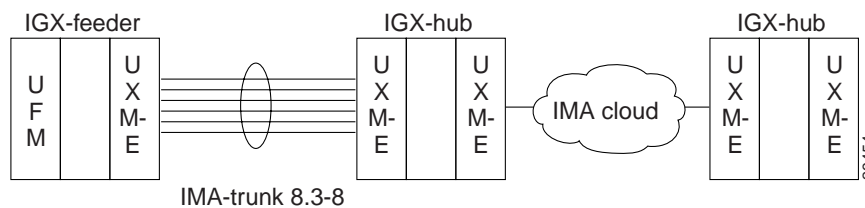
For example, you could enter **uptrk 8.1–4**. Subsequently, you would refer to this logical trunk by using only the slot number and first port number—8.1 in this example—when you use other commands, such as **addtrk**, **deltrk**, **cnftrk**, and so on. Commands for viewing IMA information also include **dsppportstats**, **dspphyslns**, **dsptckcnf**, **dspfdr**, **dspnode**, and **dspphyslstat**.

Adding an IGX Feeder

The IMA feeder node feature provides redundancy in case one of the physical lines on an IMA trunk fails. This reduces the chance of a single point of failure when a single feeder trunk is out of service. In addition, this feature allows you to configure the services on a feeder node instead of a routing node.

Figure 4-5 shows an example of an IGX feeder topology.

Figure 4-5 Sample IGX Feeder Topology



Currently supported on the IGX, a Service Expansion Shelf (SES) can function as a feeder node connected to an IGX routing node using a UXM-E OC-3 interface. The UXM-E feeder node feature adds the capability to support the UXM-E interface and the IGX as a feeder node. The routing node can be an IGX or a BPX/BXM-T3, BPX/BXM-E3, or BNI. The UXM-E interface type T1/E1, nxT1/E1, T3/E3, and OC-3, SMF/MMF Extra Long Reach can be used to connect an IGX feeder node to the IGX/BPX routing node.

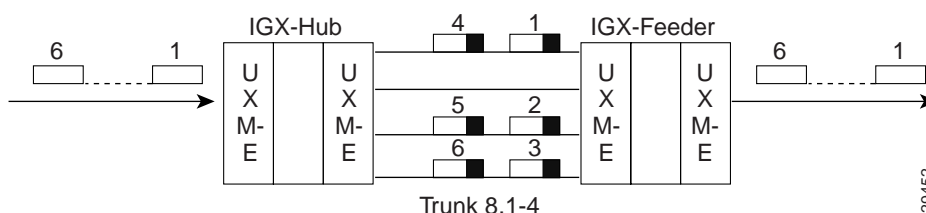
Note For a summary of commands you use to bring up an IGX node, refer to the section “IGX Configuration Summary” in *Cisco IGX 8400 Series Installation and Configuration*.

Adding and Removing IMA Group Links

When you configure an IMA trunk through Cisco WAN Manager or the **cnftrk** command, you enter the number of retained links. This represents the number of ports that must remain active for the IMA trunk itself to remain active. If a physical line goes out of service, but the number of active lines is at least as great as the retained links value, the IMA trunk remains active even though the node goes into major alarm. Also, the available load bandwidth is adjusted according to physical line status, so the switch does not reroute connections after a line failure unless the *used* bandwidth becomes greater than the *available* bandwidth.

In Figure 4-6, the number of retained links is set to 3. If line 1 fails for example, trunk 8.1-4 will continue functioning, however, the node will show major alarm due to the physical line failure.

Figure 4-6 Line Redundancy



The transmit and receive rate of an IMA trunk is the sum of all physical lines minus the IMA protocol overhead. The overhead for up to four lines is one DS0. Using the previous IMA trunk example, the maximum rates are as follows:

for trunk 8.1-4 (with T1 lines):

$$\text{TX rate} = \text{Rx rate} = 24 * 4 \text{ DS0s} - 1 \text{ DS0} = 95 \text{ DS0s}$$

You could configure the line receive rate to be the maximum bandwidth allowed on this trunk:

$$\text{total bandwidth} = \text{RX rate} = 95 \text{ DS0s}$$

You could configure the line transmit rate to be the maximum bandwidth allowed on this trunk:

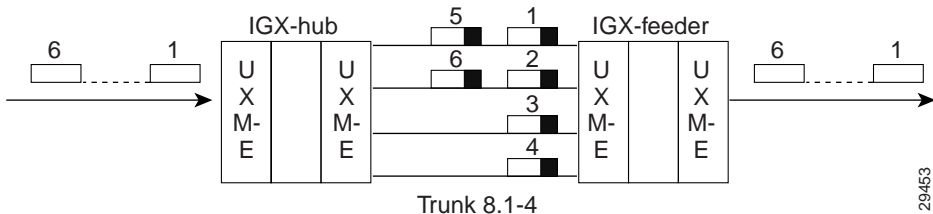
$$\text{total bandwidth} = \text{RX rate} = 95 \text{ DS0s}$$

However, if a physical line fails (and the number of retained links are still active), the switch adjusts the total bandwidth. Using the example IMA trunk consisting of four physical T1 lines:

$$\text{total bandwidth is } 95 \text{ DS0s} - 24 \text{ DS0s} = 71 \text{ DS0s}$$

Figure 4-7 shows an example of IMA protocol overhead. In the example, DS0 1 is reserved for an IMA group with 1 to 4 physical lines and DS0 2 is reserved for an IMA group with 5 to 8 physical lines.

Figure 4-7 IMA Protocol



Supported Segment Connections on the IGX Feeder Node

Figure 4-8 shows an example of configuring a two-segment connection for IGX feeder node functionality.

Figure 4-8 Sample Two-Segment Connections

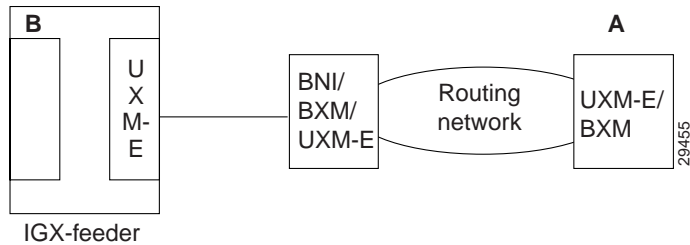


Table 4-8 lists the corresponding routing and feeder endpoints with applicable gateway and load types and also connection types.

Table 4-8 Two-Segment Connections

Routing Endpoint A	Feeder Endpoint B	Connection Type	VCC or VPC	Gateway Type	Cell Routing	Load Type
UXM-E	UXM-E	CBR	Both	GW_TYPE_NONE	True	CBR_LOAD
BXM		RT-VBR		GW_TYPE_NONE	True	CBR_LOAD
		NRT-VBR		GW_TYPE_NONE	True	VBR_LOAD
		ABR.STD		GW_TYPE_NONE	True	ABR_LOAD
		ABRFST		GW_TYPE_NONE	True	ABR_LOAD
		UBR		GW_TYPE_NONE	True	UBR_LOAD
UXM-E	UXM-E	ATFR	N/A	GW_TYPE_NWI	N/A	BDATA_LOAD

Routing Endpoint A	Feeder Endpoint B	Connection Type	VCC or VPC	Gateway Type	Cell Routing	Load Type
BXM		ATFST		GW_TYPE_NWI	N/A	BDATB_LOAD
UXM-E	UFM	ATFR	N/A	GW_TYPE_NWI	N/A	BDATA_LOAD
	FRM	ATFST	N/A	GW_TYPE_NWI	N/A	BDATB_LOAD
UFM	UFM	ATFR	N/A	GW_TYPE_NWI	N/A	BDATA_LOAD
		ATFST	N/A	GW_TYPE_NWI	N/A	BDATB_LOAD
		ATFX	N/A	GW_TYPE_SIWX	N/A	BDATA_LOAD
		ATFXFST	N/A	GW_TYPE_SIWX	N/A	BDATB_LOAD
		ATFT	N/A	GW_TYPE_SIWT	N/A	BDATA_LOAD
		ATFTFST	N/A	GW_TYPE_SIWT	N/A	BDATB_LOAD
FRM	FRM	ATFR	N/A	GW_TYPE_NWI	N/A	BDATA_LOAD

Note Two-segment voice and data connections are not supported.

Figure 4-9 shows an example of configuring a three-segment connection for IGX feeder node functionality.

Figure 4-9 Sample Three-Segment Connections

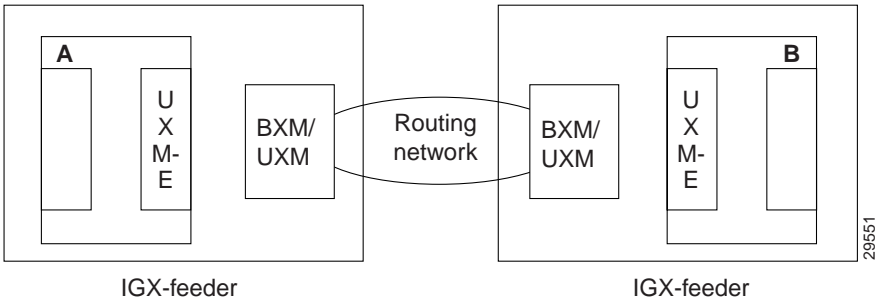


Table 4-9 lists the corresponding feeder endpoints with applicable gateway and load types and connection types.

Table 4-9 Three-Segment Connections

Feeder Endpoint A	Feeder Endpoint B	Connection Type	VCC or VPC	Gateway Type	Cell Routing	Load Type
UXM-E	UXM-E	CBR	Both	GW_TYPE_NONE	True	CBR_LOAD
		RT-VBR		GW_TYPE_NONE	True	CBR_LOAD
		NRT-VBR		GW_TYPE_NONE	True	VBR_LOAD
		ABR.FST		GW_TYPE_NONE	True	ABR_LOAD

Feeder Endpoint A	Feeder Endpoint B	Connection Type	VCC or VPC	Gateway Type	Cell Routing	Load Type
		ABR.STD		GW_TYPE_NONE	True	ABR_LOAD
		UBR		GW_TYPE_NONE	True	UBR_LOAD
UXM-E	UXM-E	ATFR	Both	GW_TYPE_NWI	N/A	BDATA_LOAD
UFM	UFM	ATFST		GW_TYPE_NWI	N/A	BDATB_LOAD
		ATFX		GW_TYPE_SIWX	N/A	BDATA_LOAD
		ATFXST		GW_TYPE_SIWX	N/A	BDATB_LOAD
		ATFT		GW_TYPE_SIWT	N/A	BDATA_LOAD
		ATFTST		GW_TYPE_SIWT	N/A	BDATB_LOAD
UXM-E	UXM-E	ATFR	N/A	GW_TYPE_NWI	N/A	BDATA_LOAD
FRM	FRM	ATFST	N/A	GW_TYPE_NWI	N/A	BDATB_LOAD
UVM	UVM	CBR	N/A	GW_TYPE_NONE	N/A	CBR_LOAD
CVM	CVM					
HDM	HDM					
LDM	LDM					

Activation and Configuration of a UXM-E in Trunk Mode

When you insert a new UXM-E into the backplane or apply power to the IGX node, UXM-E firmware reports the card type and number of physical lines on the back card. Switch software can then determine the allowed range and characteristics of trunks for you to configure. Software thus prevents you from exceeding the maximum number of trunks on the switch as you activate them through either Cisco WAN Manager or **uptrk** on the CLI.

Table 4-10 shows the trunk characteristics you can configure for each interface type through either Cisco WAN Manager or the **cnftrk** command on the CLI. Table 4-10 also shows the fixed parameters.

Table 4-10 Configurable Trunk Characteristics

Interface Type	Configurable Parameters
OC3 (STM1) SMF, EL, and MMF	<ul style="list-style-type: none"> • HCS masking (on or off) • Payload scramble (on or off) • Cell (line) framing (STS/SONET or STM/SDH) • Frame scramble (on or off)
T3	<ul style="list-style-type: none"> • HCS masking (on or off) • Payload scramble (on or off) • Cell (line) framing can be header error correction (HEC) or PLCP • Cable length (0 to 255 feet or greater than 255 feet)
E3	<ul style="list-style-type: none"> • HCS masking (on or off) • Payload scramble (on or off) • Cell (line) framing is fixed as header error Correction (HEC) • Cable length (0 to 255 feet or greater than 255 feet)

T1	<ul style="list-style-type: none">• HCS masking (on or off)• Payload scramble (on or off)• Loop clock (enable/disable)• Line framing (ESF or D4)• Cable length (0 to 655 feet, ABAM cable only)• Idle code• Line coding (fixed as B8ZS)
E1	<ul style="list-style-type: none">• HCS masking (on or off)• Payload scramble (on or off)• Line DS0 map (timeslots 0 to 31 for unframed or 1 to 15 and 17 to 31 for framed format)• Loop clock• Idle code• Line coding (fixed as HDB3)• Receive line impedance (BNC fixed at 75 ohms; DB-15 fixed at 120 ohms)

Alarms for Physical Lines and Logical Trunks

Variations exist in the way switch software supports alarms for physical lines and logical trunks for a trunk-mode UXM-E. The following list summarizes the approach to physical lines and trunks:

- A UXM-E trunk is mapped to a physical line object.
- A physical (non-IMA) trunk is mapped one-to-one with a physical line.
- An IMA trunk is mapped to more than one physical line.
- All line alarms (LOS, LOP, and so on) are reported as physical line alarms.
- Software reports other trunk alarms (such as *communication failure*, *communication break*, and so on) as trunk alarms in a manner similar to other, non-UXM-E trunk alarms.
- For non-IMA trunks, the alarm includes the physical line alarm.
- For IMA trunks, the trunk and physical line alarms are separate and distinct.

The physical layer trunk alarms include LOS, LOF, AIS, Yel, LOP, Path AIS, and Path Yel. To view these alarms, use the **dspphysln** command. When you execute **dspphysln**, any existing alarms appear as the physical line status. For a trunk with one physical line (such as an OC3 trunk or T1/E1 without IMA configured), the integrated alarm status is also shown by the **dsptrks** command.

You can enable the physical line statistical alarm on the CLI through the **cnfphyslnalm** command. You can display existing alarms through the **dspphyslnerrs** command and clear the alarms through the **clrphyslnalm** command.

To enable or disable the physical line or trunk statistical alarms, use **cnftrkalm** command. To display any outstanding alarms, use **dstrkerrs**. To clear the statistical alarms, use **clrtrkalm**.

To see the physical line and trunk statistical alarm types that apply to the UXM-E, enter the commands for configuring the alarms.

In summary, the applicable commands are **dspphyslins**, **dspphyslnerrs**, **clrphyslnalm**, **cnflnalm**, **dsptrks**, **dsptrkerrs**, **cnftrkalm**, **clrtrkalm**, **dspalms**.

SCR and PCR Policing at Less than 50 CPS on UXM-E

This section provides descriptions of lowered PCR minimum policing values supported by the BXM and UXM-E. When policing is off, connections can be set with PCR values as low as 6 cells per second (CPS). The minimum SCR value can be set to 6 CPS regardless of interfaces. Table 4-11 lists the minimum PCR values for different BXM and UXM-E cards when policing is enabled.

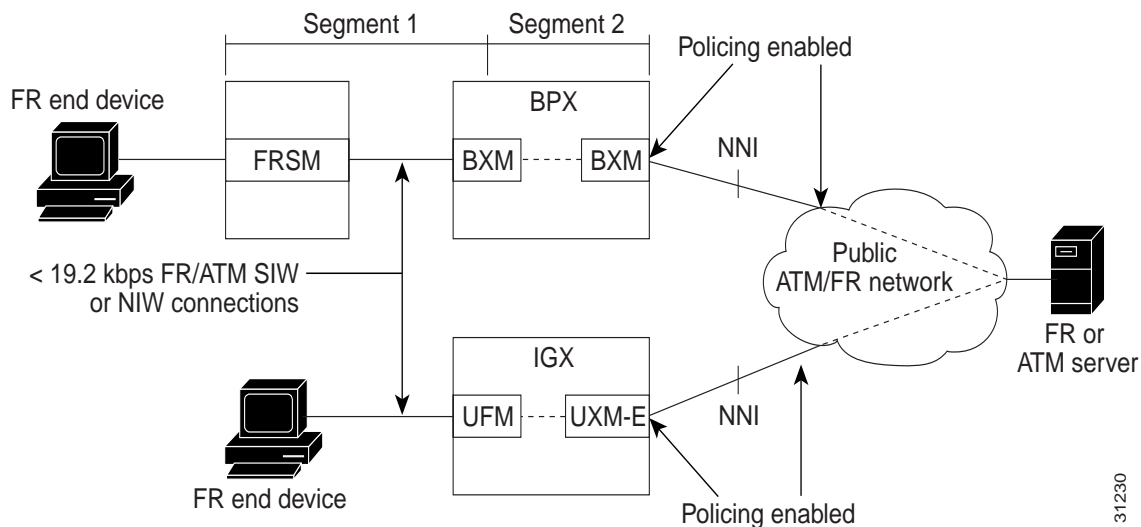
Table 4-11 PCR Minimum Values

Card Name	Card Type	Minimum PCR Policing Values
BXM	T3/E3	12 cells per second
BXM	OC-3/OC-12	50 cells per second (or equivalently 19.2 kbps)
IGX-UXM-E	T1/E1	6 cells per second
IGX-UXM-E	T1/E1 IMA	6 cells per second
IGX-UXM-E	OC-3/STM-1	50 cells per second (or equivalently 19.2 kbps)

Note The policing accuracy is always within 1%.

Figure 4-10 shows an application example enabled by the PCR minimum value feature. In the example, less than 19.2 kbps Frame and ATM connections are set up across two carrier Frame and ATM networks with the policing function enabled at the boundary of the two carrier networks. The PCR value of segment 2 is set to the new minimum PCR policing value supported by the NNI facing BXM. For the BXM cards where the minimum PCR values are lowered, over-provisioning of bandwidth for low speed connections (on segment 2) is reduced or eliminated.

Figure 4-10 PCR Policing Application Example



Note Firmware revision Model B must be used on all cards to avoid card mismatch.

Trunk Statistics for Troubleshooting

In Release 9.3, switch software separates the UXM-E trunk statistics into physical statistics and logical statistics. (This separation is a deviation from other schemes for trunk statistics management.) The commands in this section are useful primarily for troubleshooting.

The CLI commands **cnfphyslnstats**, **dspphyslnstatscnf**, and **dspphyslnstathist** apply to the statistics for physical lines within an IMA trunk. You can enable the physical line statistics by using **cnfphyslnstats**, display the configuration for statistics with **dspphyslnstatcnf**, and display the statistics themselves with **dspphyslnstathist**.

The logical trunk statistics includes Qbin statistics, VI statistics, and gateway statistics. To enable statistics using the Cisco WAN Manager, you must use the TFTP mechanism. To configure the logical trunk statistics through the CLI, use **cnftrkstats**. The **dsptrkstatcnf** command shows the configuration of the trunk statistics. To display the logical trunk statistics, use **dsptrkstathist**. These three commands primarily apply to debugging.

Software also supports statistics for trunk ports. Use the **dspportstats** command to display these statistics.

In summary, the following commands let you manage trunk statistics: **cnfphyslnstats**, **cnftrkstats**, **dspphyslnstatcnf**, **dspphyslnstathist**, **dsptrkstatcnf**, **dsptrkstathist**, and **dspportstats**.

Summary Statistics

You can view summary statistics for a UXM-E trunk through Cisco WAN Manager or the CLI. The CLI commands are **dspportstats** and **dsprkstats**.

With **dspportstats**, you can view:

- Port statistics
- IMA statistics
- ILMI/ILMI statistics

With **dsprkstats**, you can view:

- Qbin statistics
- Gateway statistics
- Virtual interface statistics

UXM-E Interface Cards

This section provides basic information on the interface back cards for the UXM-E. The information consists of a general description, an illustration of the card faceplate, and a table describing the connectors and status LEDs. For details on the line technology of each type of interface, see the appendix “System Specifications.”

Note The T1 and E1 back cards do not have Active and Fail LEDs to indicate *card* status (rather than the port status indicated by the tri-color LEDs). If a T1 or E1 back card failure is detected, all of the tri-color LEDs turn red.

The model numbers of the back cards and the order of their appearance are:

- BC-UAI-4-155-MMF
- BC-UAI-4-155-SMF
- BC-UAI-2-155-SMF
- BC-UAI-2-SMFXLR
- BC-UAI-4-SMFXLR
- BC-UAI-4-STM1E
- BC-UAI-6-T3
- BC-UAI-3-T3
- BC-UAI-8-T1-DB-15
- BC-UAI-4-T1-DB-15
- BC-UAI-6-E3
- BC-UAI-3-E3
- BC-UAI-8-E1-DB-15
- BC-UAI-8-E1-BNC
- BC-UAI-4-E1-DB-15

- BC-UAI-4-E1-BNC

OC-3/STM1 Back Cards

The OC3/STM1 back cards for the UXM-E have the single-mode fiber (SMF), multimode fiber (MMF) and electrical connections. The cards are:

- BC-UAI-2-155-SMF
- BC-UAI-4-155-SMF
- BC-UAI-4-155-MMF
- BC-UAI-2-SMFXLR
- BC-UAI-4-SMFXLR
- BC-UAI-4-STM1E

As indicated by the “2” or the “4” in the model number, these cards have two or four transmit and receive connectors. Each *line* has a tri-color LED whose color indicates its status. Each card also has a red Fail LED and a green Active LED to indicate the status of the *card*. Table 4-12 lists the connectors and LEDs. Figure 4-11 shows the four-port OC3/STM1 card. The SMF, STM1E, SMFXLR, and MMF versions appear the same. Figure 4-12 shows the two-port OC3/STM1 card. For technical data on OC3/STM1 lines, see the appendix “System Specifications.”

Table 4-12 Connectors and LEDs for SMF and MMF Back Cards

Connector/Indicator	Function
Transmit and receive	SC connector for SMF and MMF
Red (on the tri-color LED)	On indicates line is active but a local alarm was detected.
Yellow (on the tri-color LED)	On indicates line is active but a remote alarm was detected.
Green (on the tri-color LED)	On indicates line is active.
Fail light (red)	An error was detected. Reset the card with resetcd f to clear it. If Fail comes on again, call the TAC through Cisco Customer Engineering.
Active light (green)	The card is active and in service.

Figure 4-11 BC-UAI-4-155-SMF Faceplate

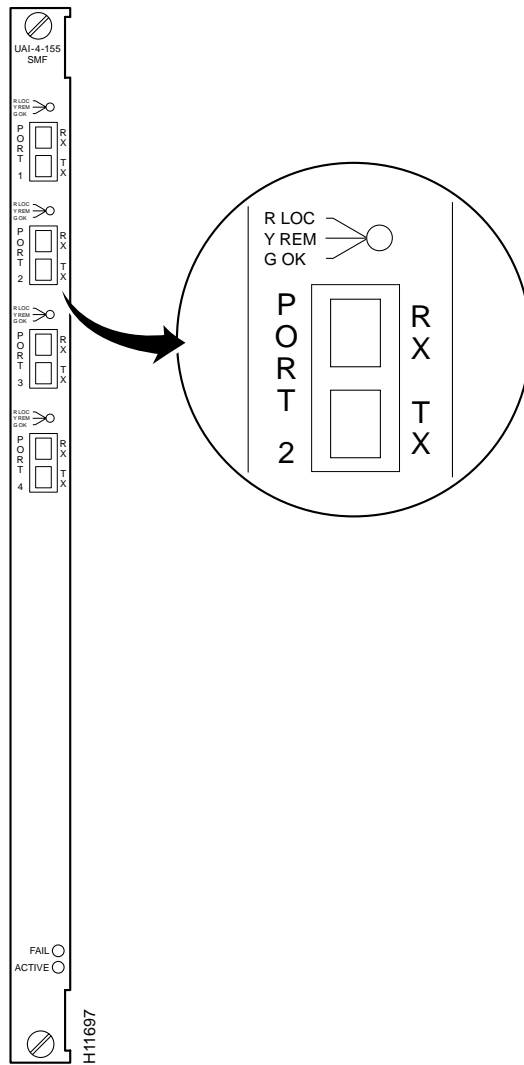
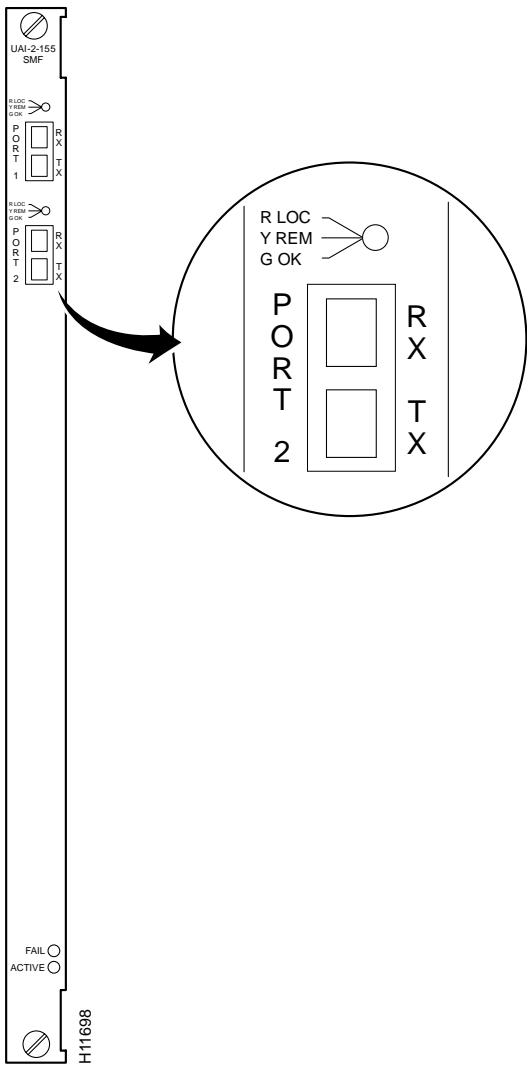


Figure 4-12 BC-UAI-2-155-SMF Faceplate



T3 Back Cards

The T3 back cards for the UXM-E are BC-UAI-6-T3 and BC-UAI-3-T3. These cards have six and three pairs of BNC connectors, respectively. Each *port* has a tri-color LED whose color indicates its status. Each card also has a red Fail LED and a green Active LED to indicate the status of the *card*. Table 4-13 lists the connectors and LEDs. Figure 4-13 show the six-port T3 card. Figure 4-14 shows the three-port T3 card. For technical data on T3 lines, see the appendix “System Specifications.”

Table 4-13 Connectors and LEDs for BC-UAI-6-T3 and BC-UAI-3-T3

Connectors/Indicator	Function
Transmit jacks	BNC connectors for transmit data.
Receive jacks	BNC connectors for receive data.
Red (on the tri-color LED)	On indicates line is active but a local alarm was detected.
Yellow (on the tri-color LED)	On indicates line is active but a remote alarm was detected.
Green (on the tri-color LED)	On indicates line is active.
Fail light (red)	An error was detected. First, reset the card with resetcd f . If Fail comes on again, call the TAC through Cisco Customer Engineering.
Active light (green)	The card is active and in service.

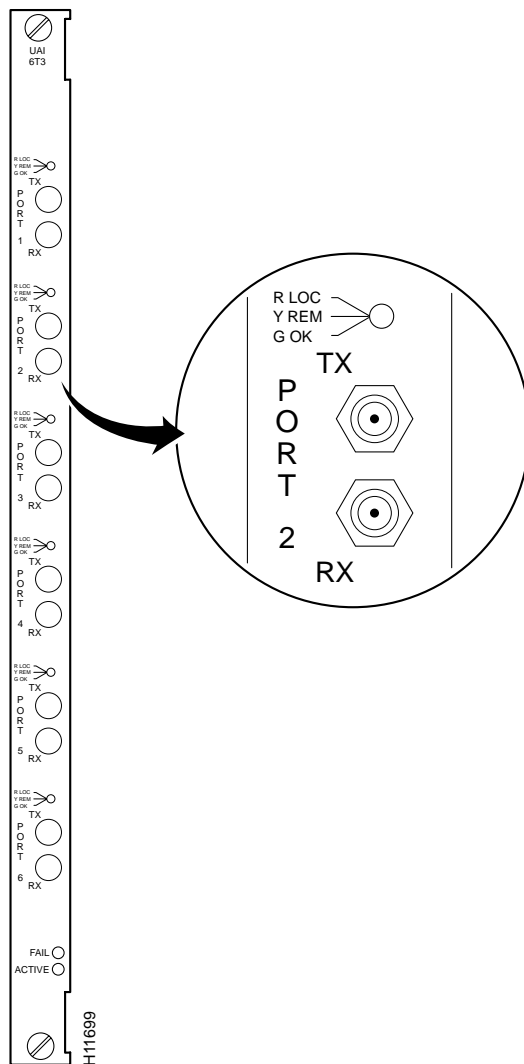
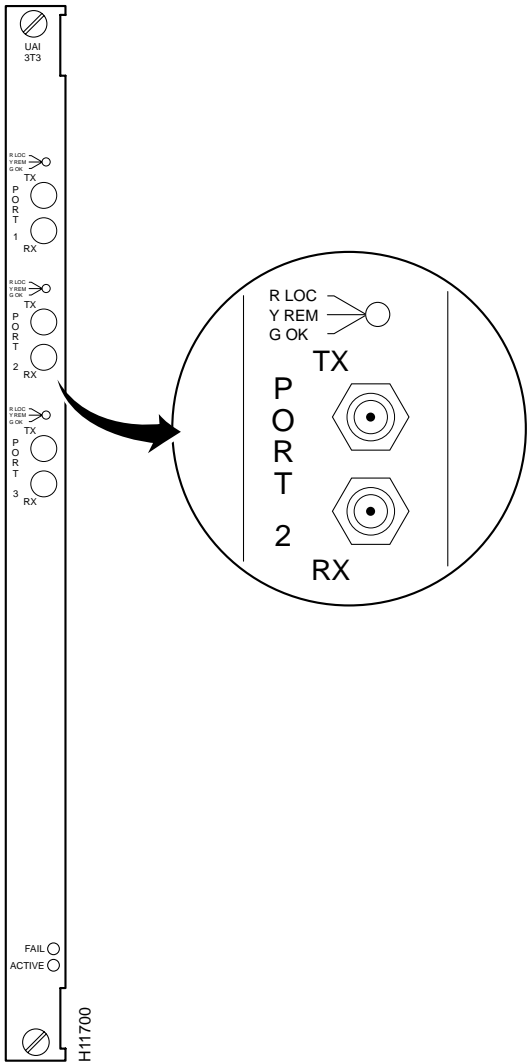
Figure 4-13 BC-UAI-6-T3 Faceplate

Figure 4-14 BC-UAI-3-T3 Faceplate



E3 Back Cards

The E3 back cards for the UXM-E are the six-port BC-UAI-6-E3 and the three-port BC-UAI-3-E3. These cards have six and three pairs of SMB connectors, respectively. Each *line* has a tri-color LED whose color indicates its status. Each card also has a red Fail LED and a green Active LED to indicate the status of the *card*. Table 4-14 lists the connectors and LEDs. Figure 4-15 show the six-port card. Figure 4-16 shows the three-port card. For technical data on E3 lines, see the appendix “System Specifications.”

Table 4-14 Connectors and LEDs for BC-UAI-6-E3 and BC-UAI-3-E3

Connector/Indicator	Function
Transmit Jack	BNC connector for transmit data.
Receive Jack	BNC connector for receive data.
Red (on the tri-color LED)	On indicates line is active but a local alarm was detected.
Yellow (on the tri-color LED)	On indicates line is active but a remote alarm was detected.
Green (on the tri-color LED)	On indicates line is active.
Fail light (red)	An error was detected. Reset the card with resetcd f to clear it. If Fail comes on again, call the TAC through Customer Engineering.
Active light (green)	The card is active and in service.

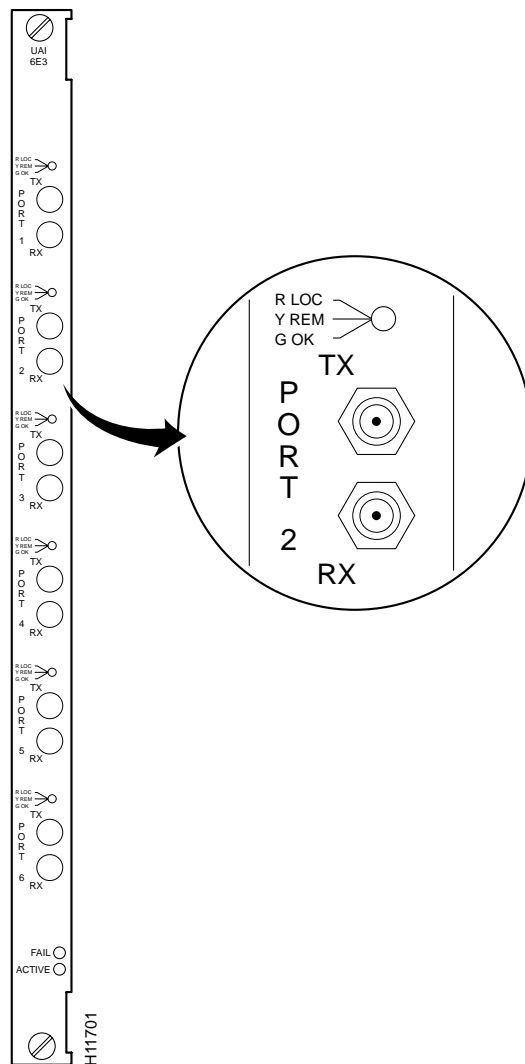
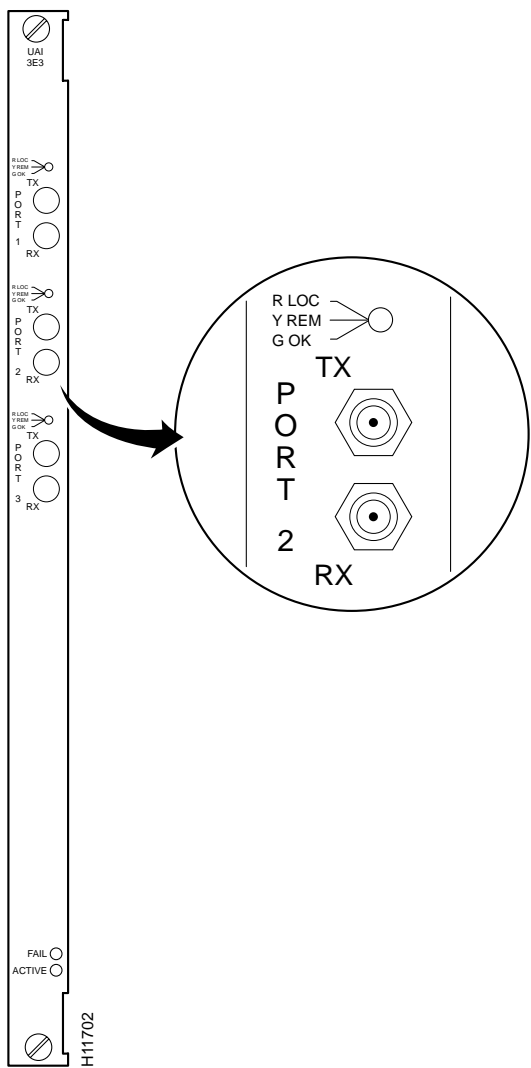
Figure 4-15 BC-UAI-6-E3 Faceplate

Figure 4-16 BC-UAI-3-E3 Faceplate



T1 Back Cards

The T1 back cards for the UXM-E are BC-UAI-8-T1-DB-15 and BC-UAI-4-T1-DB-15. These cards have eight and four DB-15 lines, respectively. Each *line* has a tri-color LED whose color indicates its status. If a card failure occurs, all the LEDs turn red. Table 4-15 lists the connectors and LEDs. Figure 4-17 show the eight-port T1 card. Figure 4-18 shows the four-port T1 card. For technical data on T1 lines, see the appendix “System Specifications.”

Table 4-15 Connectors and LEDs for BC-UAI-8-T1-DB-15 and BC-UAI-4-T1-DB-15

Connector/Indicator	Function
Four or eight DB-15s	Each DB-15 connector carries transmit and receive data.
Red (on the tri-color LED)	On indicates line is active but a local alarm was detected.
Yellow (on the tri-color LED)	On indicates line is active but a remote alarm was detected.
Green (on the tri-color LED)	On indicates line is active.

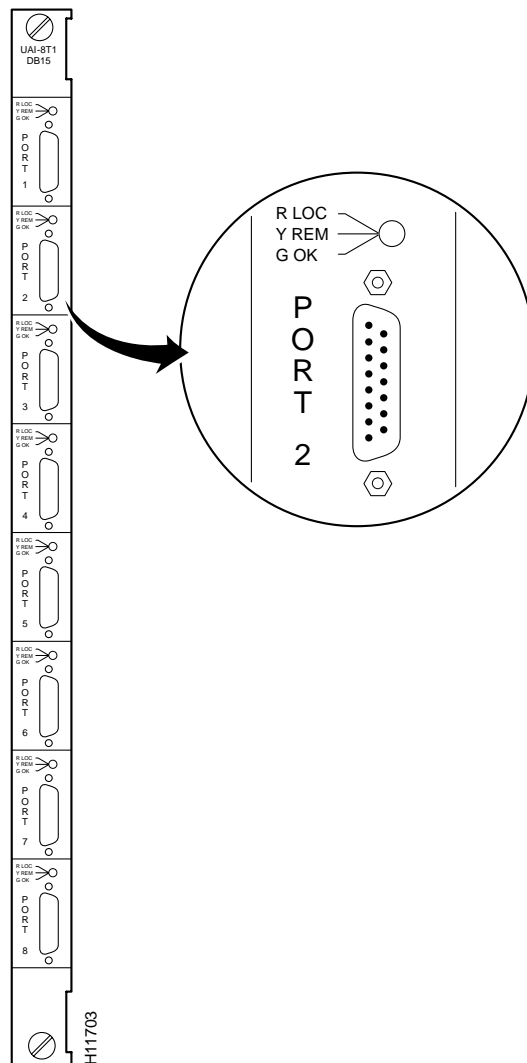
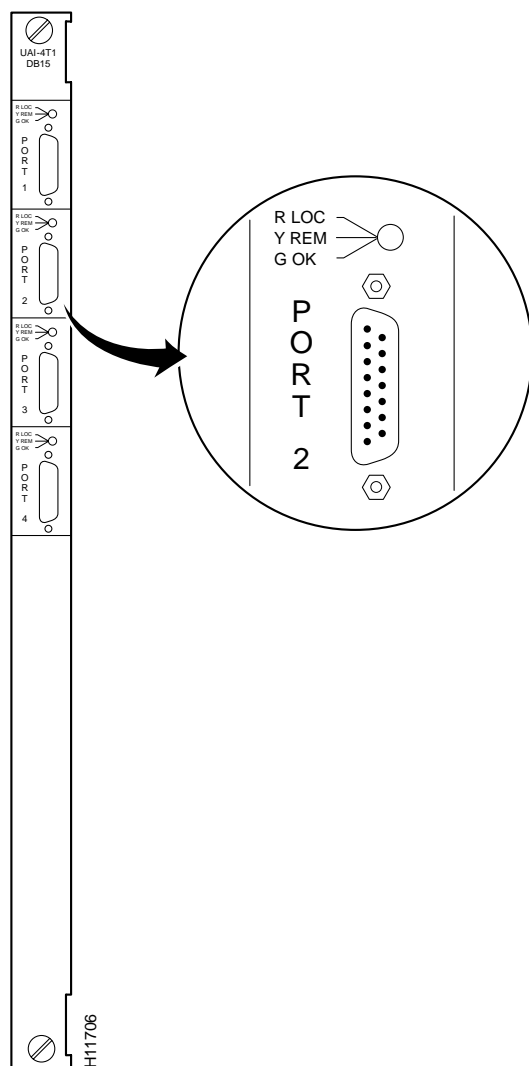
Figure 4-17 BC-UAI-8-T1-DB-15 Faceplate

Figure 4-18 BC-UAI-4-T1-DB-15 Faceplate

E1 Back Cards

The E1 back cards for the UXM-E are:

- BC-UAI-8-E1-BNC
- BC-UAI-8-E1-DB-15
- BC-UAI-4-E1-BNC
- BC-UAI-4-E1-DB-15

As the model numbers indicate, the eight and four-port E1 cards can have either BNC or DB-15 connectors. Each *line* has a tri-color LED whose color indicates its status. If a card failure occurs on the back card, all LEDs turn red. Table 4-16 lists the connectors and LEDs. Figure 4-19 shows the card. Figure 4-20 shows the card. For technical data on E1 lines, see the appendix “System Specifications.”

Table 4-16 Connectors and LEDs for BC-UAI-8-E1 and BC-UAI-4-E1

Connector/Indicator	Function
Eight or four DB-15 connectors	Each DB-15 connector carries transmit and receive data.
Eight or four pairs of BNC connectors	Each BNC connector carries traffic in one direction.
Red (on the tri-color LED)	On indicates line is active but a local alarm was detected.
Yellow (on the tri-color LED)	On indicates line is active but a remote alarm was detected.
Green (on the tri-color LED)	The card is active and in service.

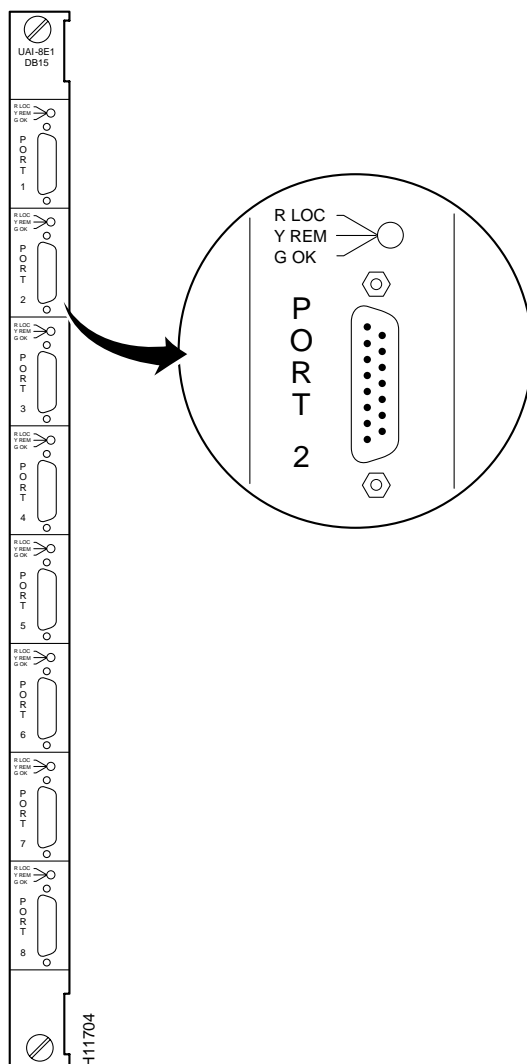
Figure 4-19 BC-UAI-8-E1 DB-15 Faceplate

Figure 4-20 BC-UAI-8-E1 BNC Faceplate

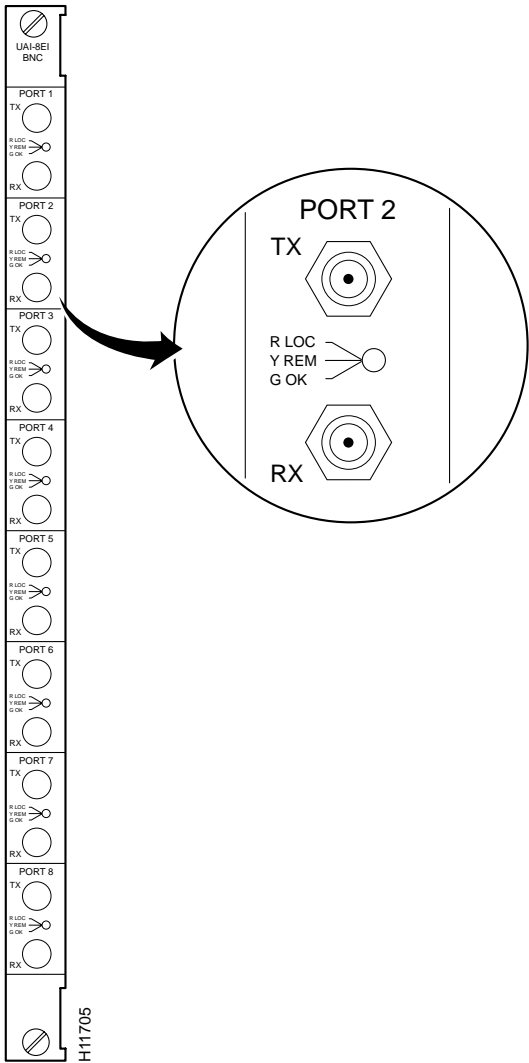


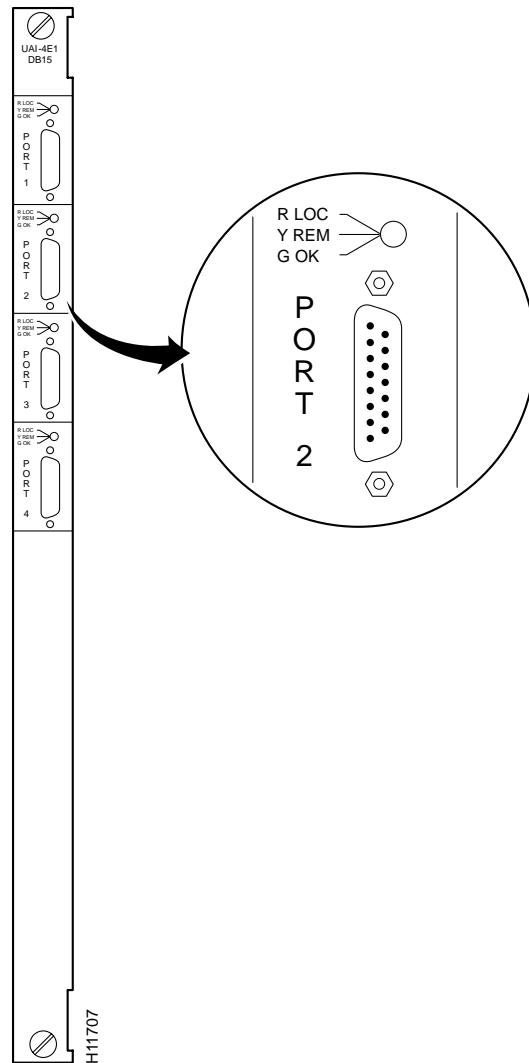
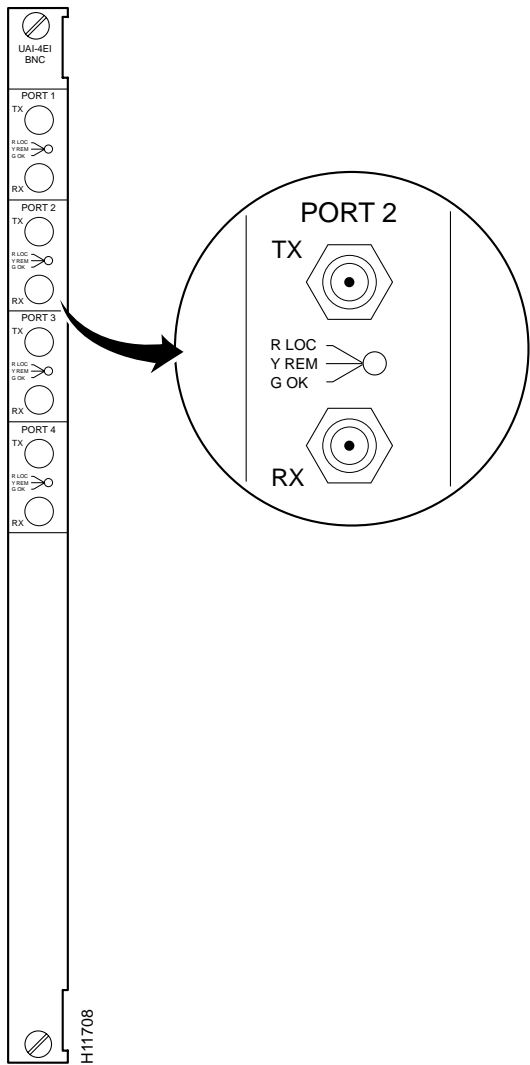
Figure 4-21 BC-UA1-4-E1 DB-15 Faceplate

Figure 4-22 BC-UAI-4-E1 BNC Faceplate



Network Trunk Module

The network trunk module (NTM) enables FastPacket transmission on a trunk. NTM functions include the following:

- Takes FastPackets off the cellbus and places them in queues before transmission to the trunk
- Arbitrates access to the trunk for the traffic type
- Monitors the age of each timestamped FastPacket, updates the timestamp for FastPackets at intermediate nodes, and discards FastPackets that exceed age limit
- Receives and checks FastPackets from the trunk and queues them for transmission to the cellbus
- Provides packet alignment based on the CRC in the FastPacket header
- Extracts clocking from the trunk that can be used as a clock source on the node or as a clock path
- Collects trunk usage statistics

Note The NTM card exists in two forms. One uses an ACM1 adaptor, and the other is a single-card or “native” version. They are functionally identical, but their firmware is not interchangeable. The native NTM requires revision F or later firmware.

An NTM can occupy any available front service card slot in the range 3 to 32. The choice of back card depends on the trunk interface type.

For fractional T1 trunk lines, the NTM and BC-T1 card set can provide the interface. A fractional trunk interface uses a group of 64-Kbps channels to create a partial T1 trunk. For example, a 512-Kbps fractional T1 trunk might use every third channel among channels 1 to 24. The user makes the channel assignments. For the clock rate, fractional trunks use the basic trunk frequency (such as 1.544 Mbps for T1).

Fractional E1 is the same as fractional T1 except that the channels are 1 to 15 and 17 to 31 (0 and 16 reserved), and the clock rate is 2.048 Mbps.

The NTM supports subrate trunks if a BC-SR back card and appropriate local bus are present. Subrate trunks interface to the transmission facility at rates in the range 64 Kbps to 2.048 Mbps. Three interface connections are possible: EIA/TIA-449, X.21, and V.35.

Y-Cable Redundancy for the NTM

You can configure the NTM for 1:1 redundancy by using a second, identical, card group in an adjacent slot and a Y-cable to connect the card sets. All NTM back cards support redundancy.

NTM Status

The faceplate of the NTM has four LEDs. The first two in the following list apply to the NTM front card. Each of the other two LEDs is a summary alarm for the back cards. Their significance is:

- The green Active LED indicates the NTM is active and functioning normally.
- The red Fail LED indicates an NTM card failure was detected.
- The yellow Minor LED indicates non-service-interrupting faults or statistical errors that have exceeded a preset threshold.
- The red Major LED indicates a service-affecting failure was detected.

For details on the significance of LEDs, see the *Cisco IGX 8400 Series Installation* manual.

The alarms and line conditions that the NTM monitors include those in the list that follows. To view errors on a trunk, use the **dsptkerrs** command. To see a list of the (user-specified) errors that **dsptkerrs** can display, use **dsptkstatcnf**.

- E1 CRC4 errors
- T1 bipolar violations
- Near end and far end frame alarms
- Alarm information signal (AIS)
- Loss of signal (LOS)
- Line signal frame sync losses
- Packet out of frame

T1 Interface Card (BC-T1)

The T1 trunk interface card (BC-T1) card terminates a single 1.544 Mbps T1 trunk line on the NTM. The BC-T1 can reside in any rear slot 3 through 8 in an Cisco IGX 8410, 3 through 16 of the Cisco IGX 8420, or 3 through 32 of the Cisco IGX 8430. The BC-T1 connects directly to the NTM.

The BC-T1 provides the following:

- Trunk line interfaces to T1 trunks at 1.544 Mbps
- Software selectable AMI or B8ZS (bipolar 8 zero-suppress) line code
- Software selectable D4 or ESF (extended super-frame) framing format
- Configuration as either full or fractional T1 service
- Extraction of receive-timing from the input signal for use as the node timing
- Software selectable line buildout for cable lengths up to 655 feet
- Passes line event information to the front card

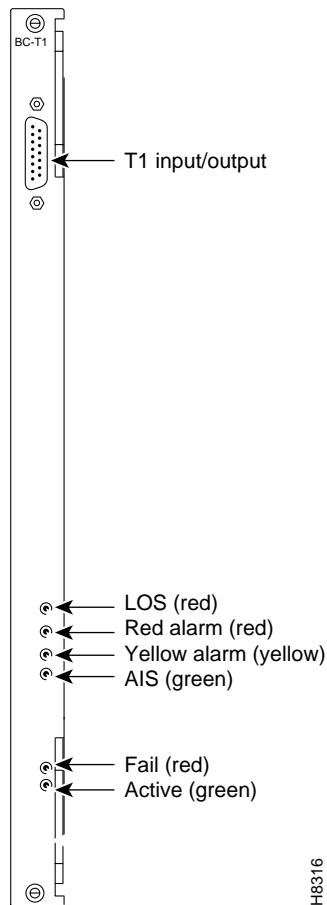
B8ZS supports clear channel operation because B8ZS eliminates the possibility of a long string of 0s. B8ZS is preferable whenever available, especially on trunks.

The BC-T1 supports two clock modes. The clock modes are *normal clocking* and *loop timing*. You select the mode through software control. With normal clocking, the node uses the receive clock from the network for the incoming data and supplies the transmit clock for outgoing data. The node can use the receive clock to synchronize itself with the network.

With loop timing, the node uses the receive clock from the network for the incoming data and redirects this receive clock to time the transmit data.

BC-T1 Faceplate Description

Figure 4-23 and Table 4-17 provide information on the faceplate of the BC-T1. When you correlate the descriptions in the table with the callouts in the figure, read from the top of the table to the bottom. The standard port connector is a female DB-15.

Figure 4-23 BC-T1 Faceplate**Table 4-17 BC-T1 Connections and Status LEDs**

Connector/Indicator	Function
T1 input/output	Female DB-15 connector for T1 line.
LOS light (red)	Indicates loss of signal at the local end.
Red alarm light (red)	Indicates loss of local E1 frame alignment, or it indicates loss of packet alignment on the NTM.
Yellow alarm light (yellow)	Indicates loss of frame alignment at remote end or loss of packet alignment (NTM).
AIS light (green)	Indicates the presence of all ones on the line.
Fail light (red)	Indicates an error occurred. First, reset the card with the resetcd f command to clear the error. If the LED comes on again, contact the TAC through Cisco Customer Engineering.
Active: light (green)	Indicates the card is in service with active circuits.

E1 Interface Back Card (BC-E1)

The E1 trunk interface card (BC-E1) provides an E1 trunk interface for the network trunk module (NTM). The BC-E1 connects directly to the NTM and can reside in any rear slot 3 through 8 in an Cisco IGX 8410, 3 through 16 in an Cisco IGX 8420, or 3 through 32 in an Cisco IGX 8430. The BC-E1 provides the following:

- Interfaces to CEPT E1 lines (CCITT G.703 specification)
- Support for both Channel Associated Signalling and Common Channel Signalling
- Support for unframed 32-channel (2.048 Mbps), framed 31 channel (1.984 Mbps), or 30 channel (1.920 Mbps) operation, or any $n \times 64$ Kbps rate down to 256 Kbps
- Configuration of either full or fractional E1 lines
- CRC-4 error checking
- Support for HDB3 (clear channel operation on E1 lines) or AMI
- Passes E1 line events (frame loss, loss of signal, BPV, frame errors, CRC errors, and CRC synchronization loss) to the front card
- Detection of loss of packet sync when used with the NTM
- 120-ohm balanced or 75-ohm balanced or unbalanced physical interfaces

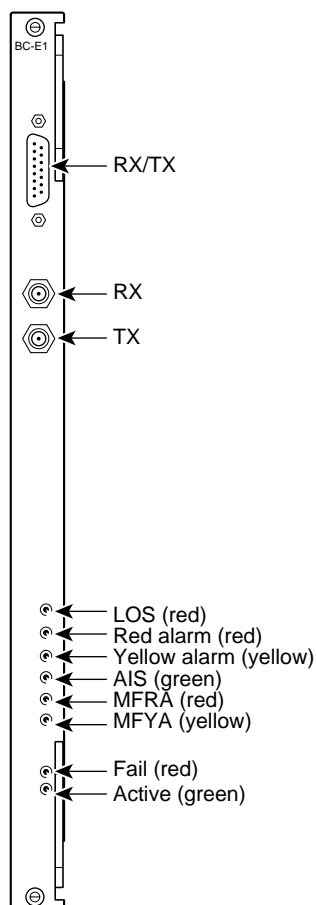
The BC-E1 supports two clock modes. The clock modes are *normal clocking* and *loop timing*. You select the mode through software control. With normal clocking, the node uses the *receive* clock from the network for the incoming data and supplies the transmit clock for outgoing data. The node can use the receive clock to synchronize itself with the network.

With loop timing, the node uses the receive clock from the network for the incoming data and redirects this receive clock to time the transmit data.

Statistics are kept on most line errors and fault conditions, including:

- Loss of signal
- Frame sync loss
- Multi-frame sync loss
- CRC errors
- Frame slips
- Bipolar violations
- Frame bit errors
- AIS, all-1's in channel 16 (CAS mode)

Figure 4-24 shows and Table 4-18 lists status LEDs and connections on the BC-E1 faceplate. When you correlate the table and figure items, read from the top to the bottom.

Figure 4-24 BC-E1 Faceplate

H8317

Table 4-18 BC-E1 Connections and Status LEDs

Connector/Indicator	Function
RX-TX	Female DB-15 connector for XMT and RCV E1.
RX	BNC connector for receive E1 line.
TX	BNC connector for transmit E1 line.
LOS light (red)	Indicates loss of signal at the local end.
Red alarm light	Indicates loss of local frame alignment. On an NTM, Red indicates loss of packet alignment.
Yellow alarm light	Indicates loss of frame alignment at remote end. On an NTM, Yellow alarm indicates loss of packet alignment.
AIS light (green)	Indicates the presence of all ones on the line.
MFRA light (red)	Indicates loss of multiframe alignment (E1 only).
MFYA light (yellow)	Indicates loss of multiframe at remote end (E1 only).
Fail light (red)	Indicates an error. Reset the card with resetcd f . If the LED comes on again, call the TAC.
Active: light (green)	Indicates the card is in service with active circuits.

Subrate Interface Card (BC-SR)

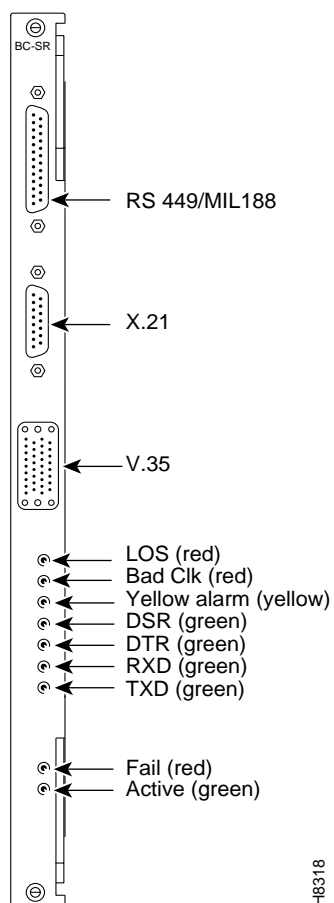
The back card/subrate (BC-SR) terminates subrate trunks on the NTM. A subrate trunk uses part of the E1 or T1 bandwidth. The BC-SR typically functions in tail circuits or where little traffic exists.

A subrate trunk facility interface operates in DCE mode, and the subrate channel functions like a synchronous data channel. Therefore, the IGX BC-SR always operates in DTE mode. Only leased lines are supported (no dial-up lines). Subrate trunks cannot pass clock signals between nodes. The BC-SR provides the following:

- Trunk line interfaces to subrate trunks
- Trunk rates of: 256 Kbps, 384 Kbps, 512 Kbps, 768 Kbps, 1.024 Mbps, 1.536 Mbps, 1.920 Mbps
- V.11/X.21, V.35, and EIA/TIA-449 interfaces
- Synchronization of the trunk clocking with looped clock option (not applicable to X.21)
- A limited set of EIA control leads monitored by the system

Figure 4-25 and Table 4-19 describe the BC-SR faceplate. When you correlate the figure and table, read from the top down.

Table 4-20 lists the data signals and EIA leads supported by the subrate interface.

Figure 4-25 BC-SR Faceplate**Table 4-19 BC-SR Connections and Status LEDs**

Connection/Indicator	Function
EIA/TIA-449 data connector	DB-37 female connector
X.21 data connector	DB-15 female connector
V.35 data connector	34-pin female MRAC connector
LOS light (red)	Loss of signal at the local end
Bad CLK light (red)	Loss of clock or clock out of range
Yellow alarm light (yellow)	Loss of packet alignment (NTM) or frame alignment at remote end
DSR light (green)	The DSR lead is high (ON)
DTR light (green)	The DTR lead is high (ON)
RXD light (green)	The receive data line shows activity
TXD light (green)	The transmit data line shows activity
Fail light (red)	An error occurred. First, reset the card with resetcd f . If the LED comes on again, contact the Cisco TAC through Customer Engineering
Active: light (green)	The card is in service and has active circuits

Table 4-20 Data and Control Leads Supported with BC-SR

Transmit			Receive		
Lead	Name	Interface	Lead	Name	Interface
TX	Transmit data	All	RX	Receive data	All
RTS	Request to Send	V.35	CTS	Clear to Send	V.35
DTR/C	Data Terminal Ready	All	DSR/I	Data Set Ready	All
LL	Local Loop	EIA/TIA-422	DCD	Data carrier select	V.35
RL	Remote Loop	EIA/TIA-422	RI/IC	Ring Incoming Call	V.35
IS	Terminal In Service	EIA/TIA-422	TM	Test mode	V.35
SS	Select standby	V.35	SB	Standby indicator	
SF	Sig rate select		SI	Signalling rate	

Y1 Interface Back Card (BC-Y1)

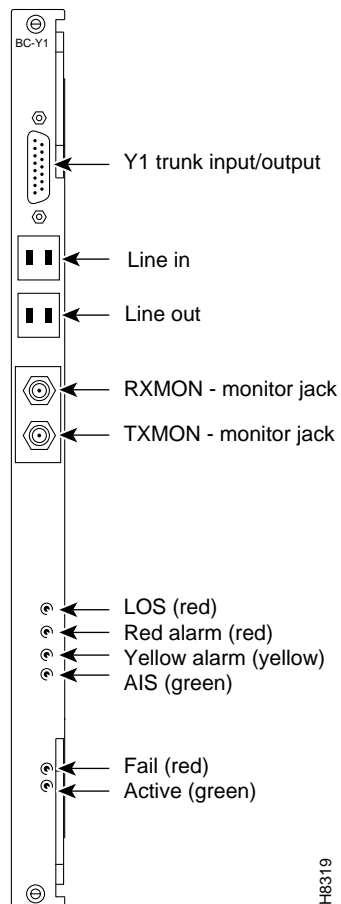
The BC-Y1 back card provides a Japanese Y1 trunk interface for an NTM. The BC-Y1 can reside in any rear slot 3 through 8 in an Cisco IGX 8410, 3 through 16 in an Cisco IGX 8420, or 3 through 32 in an Cisco IGX 8430. The BC-Y1 provides:

- An interface to Japanese “Y” Trunk (Y1) lines
- Support for Y1 trunk formatted signaling
- Support for 24-channel, 1.544 Mbps operation
- Support for fractional rates
- Coded Mark Inversion (CMI) line coding
- Statistics for Y1 line events (such as loss of framing, loss of signal, and framing errors.)
- Support for local and remote loopback at the Y1 interface and the local bus interface for fault isolation

The BC-Y1 supports two clock modes. These are *normal clocking* and *loop timing*. The system operator selects the mode through software control. Normal clocking uses the receive clock from the network for incoming data and supplies the transmit clock for outgoing data. This clock can be used to synchronize the node.

Loop timing uses the receive clock from the network for the incoming data and turns the receive clock around for timing the transmit data.

Figure 4-26 and Table 4-21 provide descriptions of the BC-Y1 status LEDs and connections on the faceplate. When you correlate the items in the figure and table, read from the top to the bottom.

Figure 4-26 BC-Y1 Faceplate**Table 4-21 BC-Y1 Connections and Status LEDs**

Connector/Indicator	Function
Y1 Trunk input/output	DB-15 connector for Y1 trunk
Line in	Y1 trunk input line
Line out	Y1 trunk output line
RX MON	BNC test connector for monitoring receive Y1 line
TX MON	BNC test connector for monitoring transmit Y1 line
LOS light (red)	Indicates loss of signal at the local end
Red alarm light (red)	Indicates loss of local frame alignment
Yellow alarm light (yellow)	Indicates loss of frame alignment at the remote end
AIS light (green)	Indicates the presence of all ones on the line
Fail light (red)	Indicates an error occurred. First, reset the card with resetcd f . If the LED comes on again, contact the TAC through Customer Engineering
Active light (green)	The card is in service and has active circuits

